Higgs Plans Towards Summer Conferences: Discussion Topics

Setting The Stage: Recent Activities & Highlights

- Higgs review in Dec'10 exercised every channel (15)
  - **Action Item**: "..important that each analysis establish a clear and concise minimal set of tasks to accomplish in order to make it in time for EPS & LP. In many cases presentations showed a very ambitious program but not where the line may be drawn to make it on time for these conferences. **A roadmap with an associated timeline for this set of tasks should also be elaborated and the people associated to each identified "** → **Next 4 weeks ?**

Analyses Targeted For Summer '11

$H \rightarrow WW \rightarrow 2l\,2\nu$ + 0,1 jets	$H^+ \rightarrow \tau\nu$ in ttbar (leptonic modes)
VBF $H \rightarrow WW \rightarrow 2l\,2\nu$	$H^+ \rightarrow \tau\nu$ in ttbar (hadronic modes)
VBF $H \rightarrow WW \rightarrow l\,\nu\,qq'$	$H \rightarrow \gamma\gamma$
$H \rightarrow ZZ \rightarrow 4l$	$H \rightarrow \gamma\gamma$ (Fermiophobic)
$H \rightarrow ZZ \rightarrow 2l\,2\nu$	$\phi \rightarrow \tau\tau$; $bb\phi$
$H \rightarrow ZZ \rightarrow 2l$ 2jet	VBF $H \rightarrow \tau\tau$
$H \rightarrow ZZ \rightarrow 2l\,2b$	VH; $H \rightarrow bb$
$H^{++}\,H^{--} \rightarrow 4l$	

The "start" menu is independent of luminosity acquired by cutoff dates : June 1st (EPS), July 1st (LP11)
But some **analyses** may fall off the wagon because of lack of sufficient data, triggers or manpower to accomplish it

2011 Summer Publication Strawman Plan

- Target date is EPS (21 July) and then LP'11 (22 August)
- Steps towards these dates (very limited contingency)
  - **March 1**: Gather & complete work breakdown by manpower (names of who does what) and by calendar week; review
  - **March 15**: "Freeze" analyses methods; Put in place team of mentors & editors for each analysis paper
  - **April 1**: Start AN and paper documentation; begin accumulation & digestion mode
  - **April 15** onwards: Biweekly updates on each analysis & limits with the data set acquired till then, check vs expectation
  - **June 15**: Preapproval for EPS bound analyses based on data till June 1 starts. One month to complete ARC review and CRW
  - July 22: Reload with data taken till July 1 ?
    - **lite reviews for LP'11 that made EPS, full review of those that failed**

Your Input Needed

Broadbrush Answers to Specific Questions (1)

Are the main inputs and tools ready ? Trigger, definition of data set, object id, statistical tools, pileup handling , group Tier2 space, signal MC production

- **Trigger**
  - Mostly OK for key modes
  - **Trigger strategy for H→ bb undefined: people assembling**
  - Plan to produce a document detailing Higgs trigger strategy
- **Datasets**
  - Analyses claim AOD compatible, must verify this for all analyses
  - Foresee need to quickly re-reco dataset based on H→ γγ HLT path to apply best calibration, transparency corrections & reconstruction improvements
    - **Will need RECO or RAW-RECO dataset**
    - **Need to define method: secondary dataset, central skim ?**

Your Input Needed

Broadbrush Answers to Specific Questions (1)

Are the main inputs and tools ready ? Trigger, definition of data set, object id, statistical tools, pileup handling , group Tier2 space, signal MC production

- Tier 2 space : Efficiently used; no issues
- Object ID :
  - Decide on (lower P_T) e-ID for some modes like H →ZZ →2e2l
  - "Super" b-tag combining leptonic & topological b-tags ?
- MC production: Restarting 7 TeV campaign; Repeat Fall10 requests +
  - Increase V+jets, VV+jet samples, Herwig++ for VH→bb,
  - MC@NLO samples to compare with POWHEG (**H** P_t spectrum)
  - **Pile up in MC:**
    - **For all MC, need to be able to sample PU between 0-20**
    - **Variation of PU condition during a run by reweighting**
      - A central tool for reweighting MC ?

Your Input Needed

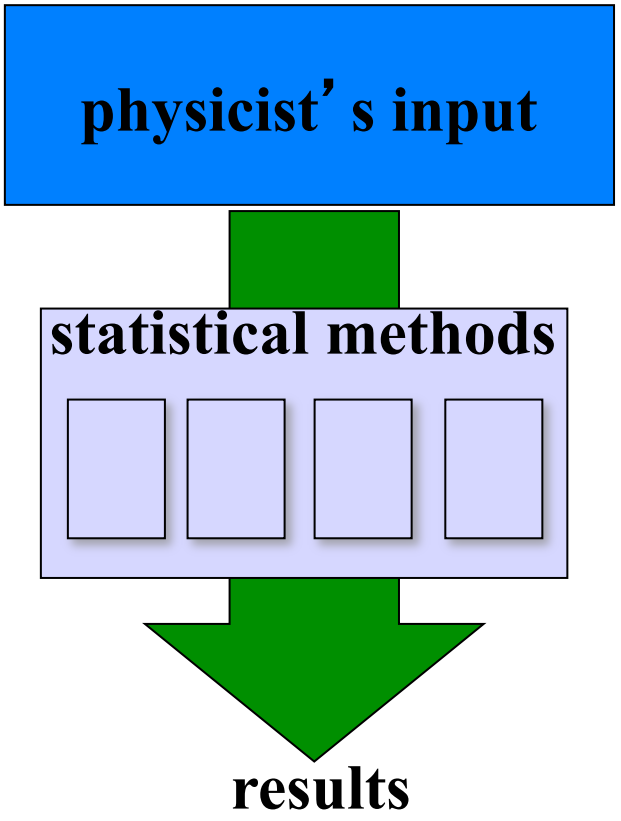
Pile Up & Its Consequences

- A very high priority action item for Feb
- In process of studying impact of PU~10-15 on several aspects of several analyses
  - Sustainable trigger strategy
  - Calorimetric isolation
  - Jet reconstruction (e.g : H→ ZZ → 2l 2jet)
  - MET
  - Primary Vertex finding (H→ γγ)
- Signal samples with <PU> =16 produced for most modes
  - Now teams have to quantify impact and develop counter-strategy
  - Common pileup tools forthcoming ?

Your Input Needed

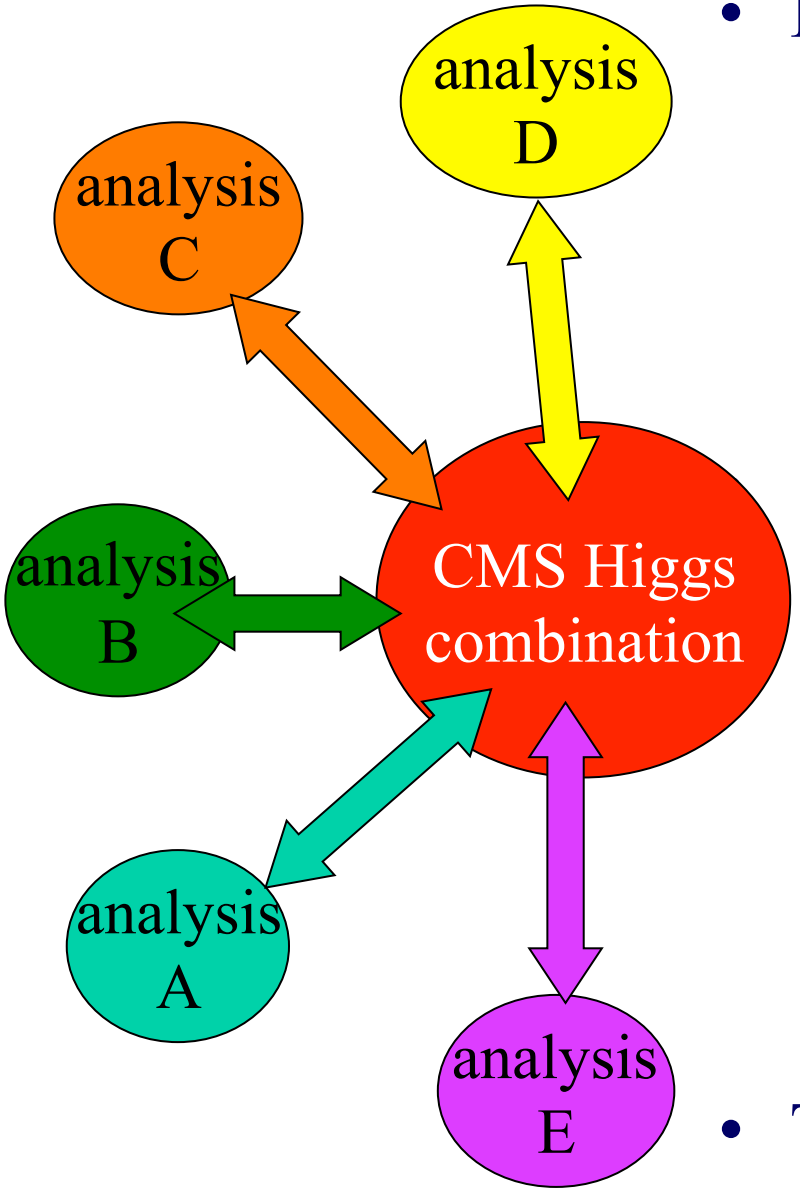
Statistical Issues: Limits, Sensitivity & Combinations

- Core team of CMS Higgs combination group in place, very active
- RooStats is the main platform
  - Extensive validation in progress
- Feb 15th PAG meeting: start of a campaign to provide statistical tools and assist analyses on evaluation of:
  - significance of an excess & best practice in setting limits
  - Assessing compatibility of observation with expectation
  - all this in a coherent, validated way
- **An urgent matter now !**



Factorize the tasks
- Physicist's input
- statistical methods
- software

Limits, Sensitivity & Combinations: Plan of Work



- Each analysis contact responsible for
  - Observed events, expected signal & bkgnd, systematic errors (shape, magnitude, correlation matrix)
  - ensuring that the format of the input is compliant with that expected

  CMS Higgs combination group will
  - provide guidelines on the format of input information
  - check/ensure self-consistency between different analyses
  - help with "pushing right buttons"
  - collate information from all analyses to prepare the overall CMS combination
- Templates with dummy numbers should be ready by **April 2nd**

Broadbrush Answers to Specific Questions (2)

Do you have manpower to cover your phase-space ? How much inefficiency you get because of people still involved on the 2010 dataset analysis ?

- Before Bodrum, lacking manpower in almost every analysis, situation is slowly improving
  - Many news groups have made commitments for 2011
    Most dramatic additions have been in H→ γγ; H→ ZZ
    - **now they have be integrated & take off !**

Your Input Needed

Broadbrush Answers to Specific Questions (3)

What do you expect from the DPG/POGs, how are "your people" working with the DPG/POGs to complete studies on efficiency, fake rate, pile-up, etc. and to improve tools for the benefit not only of their analysis but for CMS in general? Can we standardize the efficiency definition and numbers for tag-and-probe measurements? For fake rate measurements? Can we get these centralized?

- Higgs people develop tools in corresponding POGs, without exception
  - **e/γ-isolation, fake rates, conversion rejection, dielectron/γγ trigger, IP significance, etc**
- We see DPG/POG as integral part of Higgs PAG. Members are sent to POG/DPG to accomplish Higgs business
  - e.g: Strong coupling with ECAL DPG crucial for H→ γγ analysis
- For efficiency & fake rate measurements, need tools and education but ultimately we **need to be self sufficient**

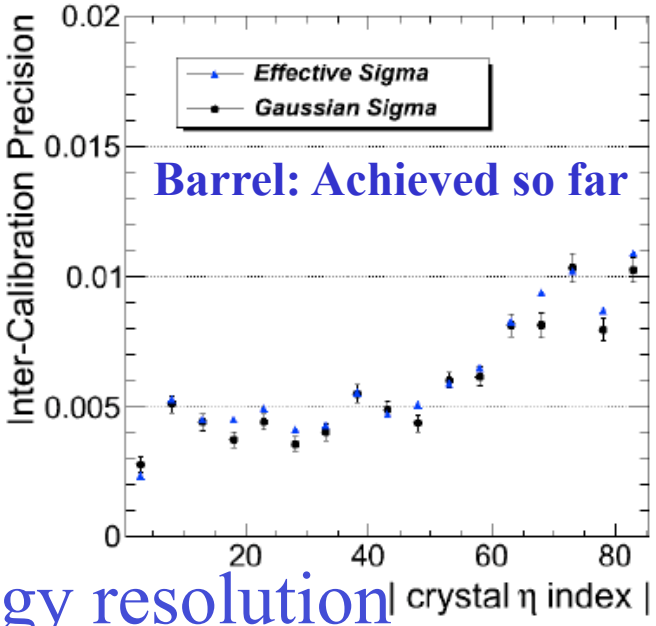
Broadbrush Answers to Specific Questions (4)

What are the most important detector aspects you depend on ? Are the relevant DPGs on board in defining how well one can optimize the use of the detector ? Is the strategy for the data preparation on that particular aspect defined (eg do you plan a reprocessing to get the best ecal calibration ?

Your Input Needed

H→ γγ: Example Of DPG/POG/PAG Alliance

- Time variation of
  - Xtal intercalibration
  - Corrections to collected light
- Endcap alignment an issue ?
- Dead channels and boundaries
  - How to properly preserve good energy resolution
  - Trigger rates & thresholds
- How can preshower detector inprove prompt photon reco ?
- Improved energy reconstruction
- etc



Broadbrush Answers to Specific Questions (5)

Which kind of validation do you expect in order to be able to use the data set ?

- PVT : Good job in 2010,
  - plan to add more Higgs people contributing to this group
- We rely on POGs to do object validation
  - Tracking, Egamma, Muon, JetMet, Pflow, Tau, Btag…
- Most of our analyses are based on W & Z
  - The expertise of EWK group in constantly monitoring & identifying problems and providing a "heads up" crucial
- Physics Operations meetings an ideal forum for reporting & discussion of emerging issues
  - Participation from Higgs group should improve

Broadbrush Answers to Specific Questions (6)

Is the analysis strategy in place ? How do you see the evolution wrt the 2010 analyses ? What is the lesson learnt from the 2010 experience ?

- Basic cut-based analysis strategy is in place for the most sensitive modes (See talks at Dec Higgs review)
  - http://indico.cern.ch/conferenceDisplay.py?confId=114679
- Several emerging H → ZZ, H → bb analyses have to be refined for a data driven strategy
- More advanced strategies, maximally utilizing all differences between signal & bkgnd (e.g. MVA/NN output shape), yet to be fully established → action item
  - Decide by ~15 March

Your Input Needed

Broadbrush Answers to Specific Questions (7)

How do you address the possible bias of looking at data ? How much are the search defined (eg are the analyses cut - or their evolution with integrated luminosity - frozen ?)

- Inculcate culture of **not looking at data until** the entire analysis strategy has been worked out and discussed
- Plan is to "freeze" kinematic cuts & analysis strategy before start of 2011 data taking
  - Observables related to LHC operation will, of course, evolve per conditions
  - Overall, need to think more on minimizing analysis biases
- In the early period, data samples will "double" constantly and quickly: this should help mitigate possible & unintended analyses biases (fluctuation chasing)

Your Input Needed

Broadbrush Answers to Specific Questions (8)

How do you expect your delivery as function of time ? (eg are you running constantly the analyses and you check the result every week)

- Plan is to have **updates on each analysis on a <u>15 day cycle</u>** assuming this represents a good chunk of data
  - Monitor evolution of key observables over time
  - Update limits and sensitivity for each analysis and check with the expectation

Your Input Needed

Broadbrush Answers to Specific Questions (9)

How are we ready for the validation of a new signal ? Do we have cross-checks? How do we involve experts to scrutinize for all possible detector and reconstruction effects that might have conspired to fool us ?

- A very good question !
- Answer & strategy varies by mode and by scenario
  - In general, we will rely on DPG & POG's expertise for monitoring detector and reconstruction effects. In rapidly changing scenario DPG/POG/PAG must work in tandem
  - We rely on teams of analysts to cross check each other
- But overall, We have **not** yet addressed this issue in a comprehensive manner, **but must**

Bottomline: Summer 2011

- Summer 2011 will be an exciting **challenge against time**
- As in any momentous challenge:
  - One needs manpower; this is finally coming in (slowly)
  - One must be prepared well in advance
    - **next 6-8 weeks critical**
  - One must be suitably sobered by the enormity and crescendo of effort required to meet the deadlines
    - **The drum beats are rising but this must fully sink into people's minds**

- To succeed will require all of us (DPG/POG/PAG) to work in unison and with minimum communication delay

CMS Higgs Potential